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Description

The invention relates generally to infusion pumps and IV tubing sets for the controlled delivery of fluids to a patient, and more particularly to a free flow prevention system for preventing free flow of fluid through the IV tubing when the tubing is disconnected from the infusion pump.

Background of the Invention

Infusion pumps are typically used to regulate the delivery of fluids, which may include potentially hazardous drugs, to a patient with a high degree of accuracy. Ordinarily, a roller clamp is moved to a closed position to stop flow through IV tubing before the tubing is removed from an infusion pump in order to prevent a situation that is sometimes referred to as "free flow" or "fluid runaway", that is, where the fluid is free to flow rapidly through the IV tubing without regulation by the infusion pump. Such roller clamps are effective in preventing free flow only when they are manually moved to their closed positions, and free flow or fluid runaway may occur if the roller clamp is left in its open position. As a result, an automatic free flow prevention system is now desired wherein fluid runaway is prevented regardless of whether the pump operator remembers to close a roller or slide clamp.

One approach is described in co-assigned U.S. Patent No. 4,585,441 wherein an interlock is provided to prevent removal of the IV set unless fluid flow through the tubing is stopped. The pump operator must manually close a clamp to stop fluid flow through the tubing before the infusion pump will permit removal of the IV set.

Another approach is to provide a permanent clamp on the infusion pump itself from which the IV set must be manually disconnected during removal of the IV set from the infusion pump. That approach reduces the risk of fluid runaway because the permanent clamp reduces the possibility of thoughtless removal of the IV set from the infusion pump. The act of disconnecting the IV set from the permanent clamp tends to remind the operator of the need to close the roller or slide clamp on the IV set; however, it does not eliminate the risk that the operator will remove the IV set without closing a clamp.

Other approaches include employing slide clamps to prevent or reduce the risk of removing the IV set without closing a clamp. U.S. Patent Nos. 4,586,691; 4,689,043 and 4,818,190 describe employing slide clamps to prevent fluid runaway during removal of IV sets from infusion pumps. US-A-4586691 is used to form the preamble of the appended claims.

Summary of the Invention

According to the present invention there is provided an IV tubing set as recited in claim 1.

Thus there is disclosed a free flow prevention system adapted for preventing free flow of fluid through IV tubing when the tubing is disconnected from an infusion pump. The system is designed to be easy to use, and to automatically close the IV tubing to fluid flow when the tubing is disconnected from the infusion pump.

Generally, the free flow prevention system comprises IV tubing having a lumen through which fluid may be pumped for administration to a patient, and a flexible clamp associated with the IV tubing. A pumping assembly is provided that includes pumping means for pumping fluid through the IV tubing, and releasable holding means for holding the IV tubing during operation of the pumping assembly.

The flexible clamp has a pair of clamping arms defining a variable width slot along which the IV tubing may be moved between a first position wherein the width of the slot is sufficient to permit the clamp to be positioned longitudinally along the IV tubing, and a second position wherein the width of the slot is normally less than the width of the slot at the first position. The clamping arms are resiliently biased to a closed position wherein the IV tubing is squeezed when in its second position to close the lumen to prevent fluid flow, and are movable against the bias to an open position wherein the lumen of the IV tubing is allowed to open so that flow through the lumen is permitted.

Clamp-receiving means are provided on the pumping assembly for releasably receiving the flexible clamp, and releasable clamp-opening means are provided for separating the clamping arms of the flexible clamp and moving the arms from their closed position to the open position before operation of the pumping assembly. The clamp-receiving means and clamp-opening means are mounted on the pumping assembly for movement of the clamp-opening means relative to the flexible clamp received in the clamp-receiving means between an unloading position and an operating position. In the unloading position, the clamp-opening means does not hold the arms of the flexible clamp in their open position. In the operating position, the clamp-opening means moves the arms of the flexible clamp to their open position and holds the arms in the open position.

Other features will be in part apparent and in part pointed out hereinafter.

Brief Description of the Drawing

The invention will be further described with reference to the drawing wherein corresponding reference characters indicate corresponding parts throughout the several views of the drawing, and wherein:

Fig. 1 is a perspective view of an infusion pump incorporating the free flow prevention system of the invention;

Fig. 2 is a cross-sectional view substantially along line 2-2 of Fig. 1, showing a flexible clamp of the free flow prevention system in its closed position;

Fig. 3 is a cross-sectional view similar to Fig. 2, showing the flexible clamp in its open position;

Fig. 4 is an enlarged bottom plan view of the flexible clamp of Figs. 2 and 3;

Fig. 5 is a bottom plan view similar to Fig. 4, illustrating another embodiment of the flexible clamp; and

Fig. 6 is a cross-sectional view similar to Figs. 2 and 3 showing a second embodiment of a clamp-receiving mechanism of the invention.

Presently Preferred Embodiments

The infusion pump designated in its entirety by the reference numeral 10 in Fig. 1 may be of the general type described in U.S. Patent Nos. 4,236,880; 4,277,226 and 4,322,201. Such infusion pumps are designed for use with IV tubing 12 that includes a pumping cassette having flexible walls defining fluid pumping chambers which may be compressed to regulate fluid flow through the IV tubing 12. Infusion pumps of this type are being sold by AVI, Inc., a subsidiary of Minnesota Mining and Manufacturing Company of St. Paul, Minnesota. The infusion pump 10 may alternatively be of the type commonly referred to as a "linear peristaltic pump", that is, pumps that selectively squeeze straight portions of the IV tubing to regulate or pump fluid through the IV tubing. In any event, the infusion pump 10 regulates fluid flow through the lumen of IV tubing 12 for administration to a patient.

The infusion pump 10 includes a pumping assembly shown generally at 14 employing conventional pumping means for pumping fluid through the IV tubing 12, and a releasable holding means or assembly 16 for holding the IV tubing 12 during operation of the pumping assembly 14. Clamp-receiving means, such as the walls forming an elongate passageway 18 having an open end 19, are provided on the releasable holding means 16 of the pumping assembly 14 for releasably receiving a flexible clamp 20 associated with the IV tubing 12. And releasable clamp-opening means 22 are provided for separating the clamping arms 24 of the flexible clamp 20 and moving the arms 24 from their closed position (Fig. 2) to the open position (Fig. 3) before operation of the pumping assembly 14 so that fluid can flow through the IV tubing 12.

The clamp-receiving means 18 and clamp-opening means 22 are mounted on the infusion pump 10 for movement of the clamp-opening means 22 relative to a flexible clamp 20 received in the clamp-receiving means 18 between an unloading position (Fig. 2) and an operating position (Fig. 3). In the unloading position (Fig. 2), the clamp-opening means 22 does not hold the arms 24 of the flexible clamp 20 in their open position so that flow through the lumen of the IV tubing 12 is prevented before unloading the IV tubing set from the infusion pump 10. When the clamp-receiving means 18 and clamp-opening means 22 are moved from the unloading position to the operating position (Fig. 3), the clamp-opening means 22 moves the arms 24 of the flexible clamp 20 to their open position and holds the arms 24 in the open position.

The flexible clamp 20 (Fig. 4) includes at least a pair of the clamping arms 24, which define a variable width slot 26. The IV tubing 12 may be moved along the slot 26 between a first position 28 (Fig. 4) wherein the width of the slot 26 is sufficient to permit the clamp 20 to be positioned longitudinally along the IV tubing 12, and a second position 30 wherein the width of the slot 26 is normally less than the width of the slot 26 at the first position. The clamping arms 24 are resiliently biased to a closed position (Figs. 2 and 4) wherein the IV tubing 12 is squeezed when in its second position 30 (Fig. 2) to close the lumen to prevent fluid flow. The clamping arms 24 are movable against the bias to an open position (Fig. 3) wherein the lumen of the IV tubing 12 is allowed to open so that flow through the lumen is permitted.

As shown in Figs. 2 and 3, the releasable holding means 16 is preferably in the form of a door assembly 16 including an IV pumping cassette-receiving block 32 of the type described in U.S. Patent No. 4,236,880, and a door 34 pivotably mounted on the cassette-receiving block 32 by a hinge. As described in U.S. Patent No. 4,236,880, the door assembly 16 may be manually moved between a loading and unloading position (Fig. 2) and an operating position (Fig. 3) by turning a knob 36 extending laterally outwardly from a side of the infusion pump 10. In the loading and unloading position (Fig. 2), the door assembly 16 is spaced from the main body 38 of the infusion pump 10 a distance D-1 sufficient to permit the door 34 to be pivoted outwardly for loading and unloading the pumping cassette of the IV tubing 12. When the door assembly 16 is moved to the operating posi-

tion (Fig. 3), the door assembly 16 is moved toward the main body 38 of the infusion pump 10 to bring the pumping cassette into position for proper operation of the pistons of the pumping means.

The clamp-opening means 22 includes a wedge 22 mounted on the main body 38 of the pumping assembly 14, and the clamp-receiving passageway 18 is preferably formed in the cassette-receiving block 32 of the door assembly 16. For example, a guide block 37 may be provided on the cassette-receiving block 32 to form the passageway 18. When the door assembly 16 is in its loading and unloading position (Fig. 2), the IV tubing 12 may be loaded into or unloaded from the pumping assembly 14, and the wedge 22 and flexible clamp 20 are in their unloading position after the clamp 20 is fully inserted in the clamp-receiving passageway 18. And when the door assembly 16 is moved to the operating position (Fig. 3), the flexible clamp 20 is carried along in the clamp-receiving passageway 18 toward the wedge 22 to the operating position, with at least a portion of the wedge 22 positioned between the clamping arms of the flexible clamp to move the clamping arms 24 to their open position.

A projecting portion or pin 35 preferably extends downwardly from the bottom edge 39 of the door 34. The pin 38 is adapted for releasably retaining the flexible clamp 20 in the elongate passageway 18 after the clamp 20 is manually inserted in the passageway 18 and the door 34 is closed against the cassette-receiving block 32. It will be observed that the pin 35 does not prevent removal of the clamp 20 when the door 34 is open. The pin 35 engages a ledge 40 extending laterally outwardly from the inner end of one of the clamping arms 24 to hold the clamp 20 against longitudinal movement (downwardly in Figs. 2 and 3) when the wedge 22 separates the clamping arms 24 of the clamp 20.

The flexible clamp 20 preferably comprises a body formed of thermoplastic or synthetic resin material, and a resilient spring member 42 biasing the clamping arms 24 to their closed position (Fig. 2). The body of the flexible clamp 20 includes a hinged bridging portion 44 defining an inner end of the slot 26, and the clamping arms 24. The clamping arms 24 of the clamp 20 extend outwardly (upwardly in Fig. 4) from the bridging portion 44, and terminate in free ends 46 that define the outer end of the slot 26. The free ends 46 of the clamping arms 24 are tapered inwardly toward the slot 26 and bridging portion 42 to guide the wedge 22 into the outer end of the slot 26 between the clamping arms 24.

The clamping arms 24 have inner surface portions between the inner end of the slot 26 and their free ends 46, preferably generally adjacent their free ends, that define the first (wide) position 28. And the inner end of the slot 26 may be, for example, generally adjacent the second position 30 as shown in Figs. 2-4, with a portion of the clamping arms 24 generally adjacent the bridging portion 44 defining an open area as the second (narrow) position. The slot 26 defines the longitudinal direction or axis of the clamp 20.

Abutment means, such as ledges 40 and 41 extending laterally outwardly from opposite sides of the clamp 20, may be provided on the clamp 20. The ledges 40 and 41 limit insertion of the clamp 20 into the elongate passageway 18 to a first predetermined distance, with the first and second positions 28 and 30 of the IV tubing 12 being spaced apart along the longitudinal axis of the clamp 12 a second predetermined distance substantially equal to the first predetermined distance. In other words, the ledges 40 and 41 are preferably spaced from the free ends 46 of the clamping legs 24 a distance substantially equal to the distance separating the first and second positions 28 and 30. And the cassette-receiving block 32 of the pumping assembly 14 includes a wall 48 substantially preventing movement of the IV tubing 20 into the passageway 18 as the clamp 20 is inserted into the passageway 18 so that the IV tubing 18 is moved from the first position 28 to the second position 30 when the clamp 20 is manually inserted in the passageway 18 the first predetermined distance.

A sensor 50 (Figs. 2 and 3) may be provided to determine when the clamp 20 is fully inserted in passageway 18, and the infusion pump 10 may include alarm circuitry responsive to the sensor 50, and may even be electrically disabled when the sensor 50 fails to indicate a fully inserted clamp 20. The sensor 50 includes a proximity switch 52 and a suitable linkage 54 for tripping the proximity switch 52 when the clamp 20 is fully inserted.

Fig. 5 illustrates a second embodiment of a flexible clamp 20A, which includes two bridging portions 56 joining the clamping arms 24A and defining opposite ends of the variable width slot 26A. The bridging portions 56 and/or clamping arms 24A are sufficiently flexible to permit the clamping arms 24A to be moved against the bias to their open position (Fig. 5) despite the addition of a second bridging portion 56. Fig. 5 also illustrates how a clamp-opening wedge 22A may be used with this alternative design. The wedge 22A would be driven into the slot 26A in the transverse direction (i.e., perpendicular to the sheet of the drawing in Fig. 5) to separate the clamping arms 24A.

Fig. 6 illustrates another embodiment of the free flow prevention system wherein a pivotable arm 58 is provided for releasably retaining the

flexible clamp 20B in the passageway 18B when the clamp 20B is inserted the first predetermined distance. The pivotable arm 58 is preferably pivotably mounted on the cassette-receiving block 32B so that the arm 58 moves with the door assembly 16B. The door 34B has a pivotable projecting portion 60 spring biased to a holding position (Fig. 6) for pressing or holding the pivotable arm 58 against the clamp 20B when the door 34B is moved to a closed position. And the projecting portion 60 is movable against the spring bias by the pivotable arm 58 when the clamp 20B is partially inserted in the passageway 18B and the door 34B is closed. This ability to move against the spring bias is believed to prevent jamming of the door 34B when the clamp 20B is only partially inserted in the passageway 18B.

The operation of the free flow prevention system will be described with respect to the embodiment shown in Figs. 2-4. With the IV tubing 12 at the first (wide) position 28 in the slot 26, the clamp 20 is moved longitudinally along the tubing 12 to a position appropriate for insertion of both the tubing 12 and clamp 20 into the infusion pump 10. The IV tubing 12, including the pumping cassette, if any, and the clamp 20 are then manually placed or inserted into the cassette-receiving block 32 and the clamp-receiving passageway 18, with the IV tubing 12 moving to the second position 30 in the clamp's slot 26 as the clamp 20 is inserted. The door 34 of the door assembly 16 is then closed to hold the clamp 20, cassette and IV tubing 12 in the door assembly 16, and the knob 36 is turned to pull the door assembly 16 toward the main body 38 of the pumping assembly 14. As the door assembly 16 moves toward the main body 38 of the pumping assembly 14, the wedge 22 is forced between the clamping arms 24 of the clamp 20 to move them to the open position (Fig. 3) to permit fluid flow through the IV tubing 12 during operation of the pump 10.

In order to remove the IV tubing set from the pump 10, the knob 36 is turned in the opposite direction to return the door assembly 16 to its loading and unloading position (Fig. 2), where it is spaced from the main body 38 of the pumping assembly 14. The door 34 is then opened, and the IV tubing set, including the IV tubing 12 and clamp 20, are removed from the infusion pump 20, with the the lumen of the IV tubing 12 being closed due to the clamping action of the clamping arms 24 against the tubing 12 at the second position 28. As a result, free flow through the tubing 12 is prevented during and after disconnection of the IV tubing set regardless of whether a standard roller clamp (not shown) is closed.

As various changes could be made in the above constructions without departing from the scope of the invention as defined in the following claims, it is intended that all matter contained in the above description or shown in the accompanying drawing be interpreted as illustrative and not in a limiting sense.

Claims

1. An IV tubing set adapted for use with an infusion pump (10) of the type comprising a pumping assembly (14) for pumping fluid through IV tubing (12) to regulate fluid flow through the IV tubing (12), a releasable holding assembly (16; or 16B) for holding IV tubing (12) during operation of the pumping assembly (14); the IV tubing set comprising:

   IV tubing (12) having a lumen through which fluid may be pumped for administration to a patient; and

   a clamp (20; 20A; or 20B) associated with the IV tubing (12);

   the IV tubing set being characterized in that:

   the clamp (20;20A; or 20B) is flexible and is adapted to be inserted in a clamp-receiving passageway (18; or 18B) in the infusion pump (10) before operation of the infusion pump (10);

   the flexible clamp (20; 20A; or 20B) has a pair of clamping arms (24; or 24A) defining a variable width slot (26; or 26A) along which the IV tubing (12) may be moved between a first position (28; Figure 4) wherein the width of the slot (26; or 26A) is sufficient to permit the clamp (20; 20A; or 20B) to be positioned longitudinally along the IV tubing (12), and a second position (30) wherein the width of the slot (26; or 26A) is normally less than the width at the first position (28);

   the clamping arms (24; or 24A) are resiliently biased to a closed position (Figures 2 and 6) wherein the IV tubing (12) is squeezed when in the second position (30) to close the lumen to prevent fluid flow, thereby preventing free flow of fluid when the IV tubing set is disconnected from the infusion pump (10); and

   the clamping arms (24; or 24A) are movable against their bias by insertion of a clamp-opening member (22; 22A) in the infusion pump (10) between the clamping arms (24; or 24A to spread the clamping arms (24; or 24A) to an open position (Figure 3) wherein the lumen of the IV tubing (12) is allowed to open so that flow through the lumen is permitted during operation of the infusion pump (10).

2. A free flow prevention system comprising an IV tubing set according to claim 1; and an

infusion pump (10) comprising a pumping assembly (14) for pumping fluid through the IV tubing (12), the pumping assembly (14) including a releasable holding assembly (16; or 16B) for holding the IV tubing (14) during operation of the pumping assembly (14);

the free flow prevention system being further characterized in that the infusion pump (10) has:

a clamp-receiving passageway (18; or 18B) in the pumping assembly (14) for releasably receiving the flexible clamp (20; 20A: or 20B); and

a clamp-opening member (22; or 22A) for separating the clamping arms (24; or 24A) of the flexible clamp (20; 20A; or 20B) and moving the arms (24; or 24A) from their closed position to the open position (Figure 3) before operation of the pumping assembly (14);

the clamp-receiving passageway (18; or 18B) and clamp-opening member (22; or 22A) being formed or mounted in pumping assembly (14) for movement of the clamp-opening member (22; or 22A) relative to the flexible clamp (20; 20A; or 20B) received in the clamp-receiving passageway (18; or 18B) between an unloading position (Figure 2), wherein the clamp-opening member (22; or 22A) does not hold the arms (24; or 24A) of the flexible clamp (20; 20A; or 20B) in their open position, and an operating position (Figure 3), wherein the clamp-opening member (22; or 22A) moves the arms (24; or 24A) of the flexible clamp (20; 20A; or 20B) to their open position and holds the arms (24) in the open position.

3. A free flow prevention system according to claim 2 further characterized in that the clamp-opening member (22; or 22A) includes a wedge (22; or 22A) mounted on the pumping assembly (14) for separating the clamping arms (24; or 24A) of the flexible clamp (20; 20A; or 20B), the wedge (22; or 22A) and the flexible clamp (20; 20A; or 20B) being movable relative to one another between the operating position (Figure 3), wherein at least a portion of the wedge (22; or 22A) is positioned between the clamping arms (24; or 24A) to separate and hold the arms (24; or 24A) in their open position, and the unloading position (Figure 2), wherein the wedge (22; or 22A) is not opening the clamping arms (24; or 24A) from their closed position so that the lumen of the IV tubing (12) is closed to fluid flow when the IV tubing (12) is removed from the pumping assembly (14).

4. A free flow prevention system according to claim 3 further characterized in that the clamp-receiving passageway (18; or 18B) is formed in the releasable holding assembly (16; or 16B) and has an open end for receiving the flexible clamp (20; or 20B), and the releasable holding assembly (16; or 16B) is movable between a loading and unloading position (Figure 2) relative to the infusion pump (10), wherein the IV tubing (12) may be loaded into or unloaded from the pumping assembly (14) and the wedge (22) and flexible clamp (20; or 20B) are in their unloading position, and the operating position (Figure 3) wherein the IV tubing (12) is held for operation of the pumping assembly (14), the wedge (22) being mounted on the infusion pump (10) and positioned in the clamp-receiving passageway (18; or 18B) such that the clamping arms (24) of the flexible clamp (20 or 20B) are moved from their closed position to their open position by the wedge (22) when the releasable holding assembly (16; or 16B) is moved to the operating position.

5. A free flow prevention system according to claim 4 further characterized in that an abutment ledge (40 and 41) is provided on the clamp (20; 20A; or 20B) for limiting insertion of the clamp (20; 20A; or 20B) into the clamp-receiving passageway (18; or 18B) to a first predetermined distance, and a pivotable arm (58) or retaining pin (35) is provided for releasably retaining the flexible clamp (20; or 20B) in the clamp-receiving passageway (18; or 18B) when the clamp (20; or 20B) is inserted the first predetermined distance, the slot (26; or 26A) of the flexible clamp (20; 20A; or 20B) defining a longitudinal axis of the clamp (20; 20A; or 20B), with the first position (28) and second position (30) of the IV tubing (12) being spaced apart along the longitudinal axis of the clamp (20; 20A; or 20B) a second predetermined distance substantially equal to the first predetermined distance, the pumping assembly (14) including a wall (48) substantially preventing movement of the IV tubing (12) into the clamp-receiving passageway (18; or 18B) as the flexible clamp (20; 20A; or 20B) is inserted into the clamp-receiving passageway (18; or 18B) so that the IV tubing (12) is moved from the first position (28) to the second position (30) when the flexible clamp (20; 20A; or 20B) is inserted in the clamp-receiving passageway (18; or 18B) the first predetermined distance.

6. A free flow prevention system or IV tubing set according to claims 1 or 3 further characterized in that the clamp-opening member (22) is

in the form of a wedge (22) mounted on the pumping assembly (14) for movement relative to the clamp-receiving passageway (18; or 18B) between the unloading position (Figure 2) and operating positions (Figure 3); the free flow prevention system or IV tubing set being further characterized in that the flexible clamp (20; or 20B) further comprises a hinged bridging portion (44) defining an inner end of the slot (26), the clamping arms (24) of the clamp (20; or 20B) extending outwardly from the hinged bridging portion (44) and terminating in free ends (46) that define the outer end of the slot (26), the free ends (46) of the arms (24) being tapered inwardly toward the slot (26) end bridging portion (44) to guide the wedge (22) into the outer end of the slot (26) between the clamping arms (24), the clamping arms (24) defining a portion (30) of the slot (26) generally adjacent the inner end of the slot (26) as the second position (30) having a width normally less than the width of the slot (26) at the first position (28), and the clamping arms (24) having portions (28) generally adjacent their free ends (46) that define an open area (28) generally adjacent the free ends (46) as the first position (28) wherein the width of the slot (26) is sufficient to permit the clamp (20; or 20B) to move longitudinally along the IV tubing (12).

7. A free flow prevention system or IV tubing set according to claims 1, 2 or 6 further characterized in that the clamping arms (24) and bridging portion (44) of the flexible clamp (20) comprise a body formed of thermoplastic or synthetic resin material and a resilient spring member (42) biasing the clamping arms (24) to their closed position.

8. A free flow prevention system or IV tubing set according to claim 7 further characterized in that the clamping arms (24) extend in a longitudinal direction of the clamp (20; or 20B) and the slot (26) is elongate in the longitudinal direction of the clamp (20; or 20B), the clamp (20; or 20B) further comprising two ledges (40 and 41) extending laterally outwardly from opposite clamping arms (24) at substantially the same longitudinal position along the arms (24) for limiting the distance the flexible clamp (20) can be inserted into the clamp-receiving passageway (18; or 18B) to a first predetermined distance, the first position (28) and second position (30) being spaced apart along the slot (26) a second predetermined distance substantially equal to the first predetermined distance.

Patentansprüche

1. Intravenöse Schlauchanordnung zur Verwendung bei einer Infusionspumpe (10) des Typs umfassend eine Pumpanordnung (14), die Flüssigkeit durch den intravenösen Schlauch (12) pumpt, um den Durchfluß durch den intravenösen Schlauch (12) zu regulieren, eine lösbare Halteanordnung (16; oder 16B), die den intravenösen Schlauch (12) während des Betriebs der Pumpanordnung (14) hält; wobei die intravenöse Schlauchanordnung folgendes umfaßt:
einen intravenösen Schlauch (12) mit einem Lumen, durch das Flüssigkeit zwecks Verabreichung an einen Patienten gepumpt werden kann; und
eine Klammper (20; 20A; oder 20B), die zu dem intravenösen Schlauch (12) gehört;
wobei die intravenöse Schlauchanordnung dadurch gekennzeichnet ist, daß:
die Klammer (20; 20A; oder 20B) flexibel ist und vor Inbetriebnahme der Infusionspumpe (10) in eine die Klammer aufnehmende Nut (18; oder 18B) eingesetzt werden kann;
die flexible Klammer (20; 20A; oder 20B) ein Paar Klemmarme (24; oder 24A) besitzt, die einen Schlitz (26; oder 26A) variabler Breite begrenzen, an dem entlang der intravenöse Schlauch (12) zwischen einer ersten Position (28; Fig. 4), in der die Breite des Schlitzes (26; oder 26A) ausreicht, um die Klammer (20; 20A; oder 20B) in Längsrichtung entlang des intravenösen Schlauches (12) positionieren zu können, und einer zweiten Position (30), in der die Breite des Schlitzes (26; oder 26A) normalerweise geringer ist als die Breite an der ersten Position (28), bewegt werden kann;
die Klemmarme (24; oder 24A) elastisch in Richtung auf eine geschlossene Position (Fig. 2 und 6) vorgespannt sind, wobei der intravenöse Schlauch (12) zusammengedrückt wird, wenn er sich in der zweiten Position (30) befindet, um das Lumen zwecks Verhinderung des Durchflusses von Flüssigkeit zu schließen, wodurch ein freier Durchfluß von Flüssigkeit verhindert wird, wenn die intravenöse Schlauchanordnung von der Infusionspumpe (10) abgekoppelt ist; und
die Klemmarme (24; oder 24A) gegen ihre Vorspannung bewegt werden können, indem ein die Klammer öffnendes Element (22; 22A) in die Infusionspumpe (10) zwischen die Klemmarme (24; oder 24A) eingesetzt wird, um die Klemmarme (24; oder 24A) in eine offene Position (Fig. 3) zu spreizen, wobei sich das Lumen des intravenösen Schlauches (12) öffnen kann, so daß ein Durchfluß durch das Lumen

während des Betriebs der Infusionspumpe (10) möglich ist.

2. System zur Verhinderung des freien Durchflusses, umfassend eine intravenöse Schlauchanordnung nach Anspruch 1; und eine Infusionspumpe (10) mit einer Pumpanordnung (14), die Flüssigkeit durch den intravenösen Schlauch (12) pumpt, wobei die Pumpanordnung (14) eine lösbare Halteanordnung (16; oder 16B) umfaßt, die den intravenösen Schlauch (14) während des Betriebs der Pumpanordnung (14) hält;
wobei das System zur Verhinderung des freien Durchflusses des weiteren dadurch gekennzeichnet ist, daß die Infusionspumpe (10) folgendes besitzt:
eine die Klammer aufnehmende Nut (18; oder 18B) in der Pumpanordnung (14) zur lösbaren Aufnahme der flexiblen Klammer (20; 20A; oder 20B); und
ein die Klammer öffnendes Element (22; oder 22A), das die Klemmarme (24; oder 24A) der flexiblen Klammer (20; 20A; oder 20B) voneinander trennt und die Arme (24; oder 24A) vor Inbetriebnahme der Pumpanordnung (14) von ihrer geschlossenen Position in die offene Position (Fig. 3) bewegt;
wobei die die Klammer aufnehmende Nut (18; oder 18B) und das die Klammer öffnende Element (22; oder 22A) in der Pumpanordnung (14) so ausgebildet oder angebracht ist, daß sich das die Klammer öffnende Element (22; oder 22A) in bezug auf die in der die Klammer aufnehmenden Nut (18; oder 18B) aufgenommenen flexiblen Klammer (20; 20A; oder 20B) zwischen einer Trennposition (Fig. 2), wo das die Klammer öffnende Element (22; oder 22A) die Arme (24; oder 24A) der flexiblen Klammer (20; 20A; oder 20B) nicht in ihrer offenen Position hält, und einer Arbeitsposition (Fig. 3), in der das die Klammer öffnende Element (22; oder 22A) die Arme (24; oder 24A) der flexiblen Klammer (20; 20A; oder 20B) in ihre offene Position bewegt und die Arme (24) in der offenen Position hält, bewegen kann.

3. System zur Verhinderung des freien Durchflusses nach Anspruch 2, des weiteren dadurch gekennzeichnet, daß das die Klammer öffnende Element (22; oder 22A) einen Keil (22; oder 22A) umfaßt, der auf der Pumpanordnung (14) angebracht ist, um die Klemmarme (24; oder 24A) der flexiblen Klammer (20; 20A; oder 20B) voneinander zu trennen, wobei der Keil (22; oder 22A) und die flexible Klammer (20; 20A; oder 20B) in bezug aufeinander bewegbar sind zwischen der Arbeitsposition (Fig. 3), in der mindestens ein Teil des Keils (22; oder 22A) zwischen den Klemmarmen (24; oder 24A) positioniert ist, um die Arme (24; oder 24A) voneinander zu trennen und in ihrer offenen Position zu halten, und der Trennposition (Fig. 2), in der der Keil (22; oder 22A) die Klemmarme (24; oder 24A) nicht aus ihrer geschlossenen Position öffnet, so daß das Lumen des intravenösen Schlauches (12) für den Durchfluß von Flüssigkeit versperrt ist, wenn der intravenöse Schlauch (12) von der Pumpanordnung (14) abgenommen ist.

4. System zur Verhinderung des freien Durchflusses nach Anspruch 3, des weiteren dadurch gekennzeichnet, daß die die Klammer aufnehmende Nut (18; oder 18B) in der lösbaren Halteanordnung (16; oder 16B) ausgebildet ist und ein offenes Ende zur Aufnahme der flexiblen Klammer (20; oder 20B) besitzt, und daß die lösbare Halteanordnung (16; oder 16B) in bezug auf die Infusionspumpe (10) bewegbar ist zwischen einer Anschluß- und Trennposition (Fig. 2), wo der intravenöse Schlauch (12) an die Pumpanordnung (14) angeschlossen oder von dieser getrennt werden kann, und der Keil (22) und die flexible Klammer (20; oder 20B) sich in ihrer Trennposition befinden, und der Arbeitsposition (Fig. 3), in der der intravenöse Schlauch (12) so gehalten wird, daß die Pumpanordnung (14) arbeiten kann, wobei der Keil (22) auf der Infusionspumpe (10) angebracht und in der die Klammer aufnehmenden Nut (18; oder 18B) so positioniert ist, daß die Klemmarme (24) der flexiblen Klammer (20 oder 20B) durch den Keil (22) von ihrer geschlossenen Position in ihre offene Position bewegt werden, wenn die lösbare Halteanordnung (16; oder 16B) in die Arbeitsposition bewegt wird.

5. System zur Verhinderung des freien Durchflusses nach Anspruch 4, des weiteren dadurch gekennzeichnet, daß eine Anschlagleiste (40 und 41) an der Klammer (20; 20A; oder 20B) vorgesehen ist, um das Einsetzen der Klammer (20; 20A; oder 20B) in die die Klammer aufnehmende Nut (18; oder 18B) auf eine erste vorbestimmte Strecke zu begrenzen, und daß ein schwenkbarer Arm (58) oder Haltestift (35) vorgesehen ist, um die flexible Klammer (20; oder 20B) lösbar in der die Klammer aufnehmenden Nut (18; oder 18B) zu halten, wenn die Klammer (20; oder 20B) die erste vorbestimmte Strecke eingesetzt ist, wobei der Schlitz (26; oder 26A) der flexiblen Klammer (20; 20A; oder 20B) eine Längsachse der Klammer (20; 20A; oder 20B) darstellt und die erste Position (28) und die zweite Position (30)

des intravenösen Schlauches (12) entlang der Längsachse der Klammer (20; 20A; oder 20B) eine zweite vorbestimmte Strecke voneinander entfernt sind, die im wesentlichen gleich ist der ersten vorbestimmten Strecke, wobei die Pumpanordnung (14) eine Wand (48) umfaßt, die im wesentlichen die Bewegung des intravenösen Schlauches (12) in die die Klammer aufnehmende Nut (18; oder 18B) verhindert, wenn die flexible Klammer (20; 20A; oder 20B) in die die Klammer aufnehmende Nut (18; oder 18B) eingesetzt wird, so daß der intravenöse Schlauch (12) von der ersten Position (28) in die zweite Position (30) bewegt wird, wenn die flexible Klammer (20; 20A; oder 20B) die erste vorbestimmte Strecke in die die Klammer aufnehmende Nut (18; oder 18B) eingesetzt wird.

6. System zur Verhinderung des freien Durchflusses oder intravenöse Schlauchanordnung nach Anspruch 1 oder 3, des weiteren dadurch gekennzeichnet, daß das die Klammer öffnende Element (22) in Form eines Keils (22) vorliegt, der auf der Pumpanordnung (14) angebracht ist, um sich in bezug auf die die Klammer aufnehmende Nut (18; oder 18B) zwischen der Trennposition (Fig. 2) und der Arbeitsposition (Fig. 3) bewegen zu können; wobei das System zur Verhinderung des freien Durchflusses oder die intravenöse Schlauchanordnung des weiteren dadurch gekennzeichnet ist, daß die flexible Klammer (20; oder 20B) des weiteren einen angelenkten Überbrückungsabschnitt (44) umfaßt, der ein inneres Ende des Schlitzes (26) begrenzt, wobei die Klemmarme (24) der Klammer (20; oder 20B) von dem angelenkten Überbrückungsabschnitt (44) nach außen ragen und in freien Enden (46) enden, die das äußere Ende des Schlitzes (26) darstellen, wobei die freien Enden (46) der Arme (24) sich nach innen in Richtung zu dem Schlitz (26) und dem Überbrückungsabschnitt (44) verjüngen, um den Keil (22) in das äußere Ende des Schlitzes (26) zwischen die Klemmarme (24) zu führen, wobei die Klemmarme (24) einen Abschnitt (30) des Schlitzes (26), der im allgemeinen im Bereich des inneren Endes des Schlitzes (26) liegt, als zweite Position (30) aufweisen, deren Breite normalerweise geringer ist als die Breite des Schlitzes (26) an der ersten Position (28), und wobei die Klemmarme (24) Abschnitte (28) aufweisen, die im allgemeinen im Bereich ihrer freien Enden (46) liegen und einen offenen Bereich (28), der im allgemeinen im Bereich der freien Enden (46) liegt, als erste Position (28) aufweisen, bei der die Breite des Schlitzes (26) ausreicht, damit sich die Klammer (20; oder 20B) in Längsrichtung entlang des intravenösen Schlauches (12) bewegen kann.

7. System zur Verhinderung des freien Durchflusses oder intravenöse Schlauchanordnung nach Anspruch 1, 2 oder 6, des weiteren dadurch gekennzeichnet, daß die Klemmarme (24) und der Überbrückungsabschnitt (44) der flexiblen Klammer (20) einen aus einem thermoplastischen oder Kunstharzmaterial gebildeten Körper und ein elastisches Federelement (42) aufweisen, mit dem die Klemmarme (24) in ihre geschlossene Position vorgespannt werden.

8. System zur Verhinderung des freien Durchflusses oder intravenöse Schlauchanordnung nach Anspruch 7, des weiteren dadurch gekennzeichnet, daß die Klemmarme (24) sich in einer Längsrichtung der Klammer (20; oder 20B) erstrecken, und der Schlitz (26) sich in Längsrichtung der Klammer (20; oder 20B) erstreckt, wobei die Klammer (20; oder 20B) des weiteren zwei Leisten (40 und 41) aufweist, die im wesentlichen an derselben Längsposition entlang der Arme (24) von den einander gegenüberliegenden Klemmarmen (24) seitwärts nach außen ragen, um die Strecke zu begrenzen, die die flexible Klammer (20) in die die Klammer aufnehmende Nut (18; oder 18B) eine erste vorbestimmte Strecke eingesetzt werden kann, wobei die erste Position (28) und die zweite Position (30) an dem Schlitz (26) entlang eine zweite vorbestimmte Strecke voneinander entfernt sind, die im wesentlichen gleich ist der ersten vorbestimmten Strecke.

Revendications

1. Groupe à tuyau IV, agencé de façon à pouvoir être utilisé avec une pompe à perfusion (10), du type comprenant un ensemble de pompage (14), servant à pomper un fluide par un tuyau IV (12) de manière à contrôler le débit de fluide dans le tuyau IV (12), un ensemble de retenue (16 ; ou 16B) libérable, servant à retenir le tuyau IV (12) pendant le fonctionnement de l'ensemble de pompage (14) , le groupe à tuyau IV comprenant :

   un tuyau IV (12) comportant une lumière par laquelle le fluide peut être pompé en vue de son administration à un patient ; et

   une pince (20 ; 20A ; ou 20B) associée au tuyau IV (12) ;

   le groupe à tuyau IV étant caractérisé en ce que :

   la pince (20 ; 20A ; ou 20B) est flexible et est agencée de façon à être insérée dans un passage de logement de pince (18 ; ou 18B),

situé dans la pompe à perfusion (10), avant un fonctionnement de la pompe à perfusion (10) ;

la pince flexible (20 ; 20A ; ou 20B) comporte deus branches de serrage (24 ; ou 24A) délimitant une fente (26 ; ou 26A) le long de laquelle le tuyau IV (12) peut être déplacé entre une première position (28 ; figure 4), dans laquelle la largeur de la fente (26 ; ou 26A) est suffisante pour permettre à la pince (20 ; 20A ; ou 20B) d'être positionnée dans le sens de la longueur le long du tuyau IV (12), et une seconde position (30) dans laquelle la largeur de la fente (26 ; ou 26A) est normalement inférieure à sa largeur à l'endroit de la première position (28) ;

les branches de serrage (24 ; ou 24A) sont soumises à une sollicitation élastique vers une position de fermeture (figures 2 et 6) dans laquelle le tuyau IV (12) est écrasé lorsqu'il est dans la seconde position (30) de façon à fermer la lumière en vue d'interdire un écoulement de fluide, ce qui interdit un écoulement libre de fluide lorsque le groupe à tuyau IV est débranché de la pompe à perfusion (10) ; et

les branches de serrage (24 ; ou 24A) sont agencées de façon à pouvoir être déplacées à l'encontre de la sollicitation à laquelle elles sont soumises, au moyen de l'insertion d'une pièce d'ouverture de pince (22 ; 22A), située dans la pompe à perfusion (10), entre les branches de serrage (24 ; ou 24A) de manière à écarter les branches de serrage (24 ; ou 24A) dans une position d'ouverture (figure 3) dans laquelle il est permis à la lumière du tuyau IV (12) de s'ouvrir, de sorte qu'un écoulement dans la lumière est permis pendant le fonctionnement de la pompe à perfusion (10).

2. Système d' interdiction d'écoulement libre comprenant un groupe à tuyau IV selon la revendication 1 ; et une pompe à perfusion (10) comprenant un ensemble de pompage (14) servant à pomper le fluide dans le tuyau IV (12), l'ensemble de pompage (14) comprenant un ensemble de retenue (16 ; ou 16B) libérable servant à retenir le tuyau IV (2) pendant le fonctionnement de l'ensemble de pompage (14) ;

le système d'interdiction d'écoulement libre étant en outre caractérisé en ce que la pompe à perfusion (10) comprend :

un passage de logement de pince (18 ; ou 18B) situé dans l'ensemble de pompage (14) et servant à loger d'une manière amovible la pince flexible (20 ; 20A ; ou 20B) ;

une pièce d'ouverture de pince (22 ; ou 22A) servant à séparer les branches de serrage (24 ; ou 24A) de la pince flexible (20 ; 20A ; ou 20B) et à déplacer les branches (24 ; ou 24A) de leur position de fermeture à la position d'ouverture (figure 3) avant le fonctionnement de l'ensemble de pompage (14) ;

le passage de logement de pince (18 ; ou 18B) et la pièce d'ouverture de pince (22 ; 22A) étant formés ou montés dans l'ensemble de pompage (14) de façon à permettre un déplacement de la pièce d'ouverture de pince (22 ; ou 22A), vis-à-vis de la pince flexible (20 ; 20A ; ou 20B) logée dans le passage de logement de pince (18 ; ou 18B), entre une position de démontage (figure 2), dans laquelle la pièce d'ouverture de pince (22 ; ou 22A) ne retient pas les branches (24 ; ou 24A) de la pince flexible (20 ; 20A ; ou 20B) dans leur position d'ouverture, et une position de fonctionnement (figure 3) dans laquelle la pièce d' ouverture de pince (22 ; ou 22A) déplace les branches (24 ; ou 24A) de la pince flexible (20 ; 20A ; ou 20B) à leur position d'ouverture et retient les branches (24) dans la position d'ouverture.

3. Système d'interdiction d'écoulement libre selon la revendication 2, caractérisé en outre en ce que la pièce d'ouverture de pince (22 ; ou 22A) comprend un coin (22 ; ou 22A) monté sur l'ensemble de pompage (14) et servant à séparer les branches de serrage (24 ; ou 24A) de la pince flexible (20 ; 20A ; ou 20B), le coin (22 ; ou 22A) et la pince flexible (20 ; 20A ; ou 20B) étant agencés de façon à pouvoir être déplacés l'un vis-à-vis de l'autre entre la position de fonctionnement (figure 3), dans laquelle au moins une partie du coin (22 ; ou 22A) est positionnée entre les branches de serrage (24 ; ou 24A) de façon à séparer et maintenir les branches (24 ; ou 24A) dans leur position d'ouverture, et la position de démontage (figure 2) dans laquelle le coin (22 ; ou 22A) n'ouvre pas les branches de serrage (24 ; ou 24A) à partir de leur position de fermeture, de sorte ,que la lumière du tuyau IV (12) est fermée à l'écoulement de fluide lorsqu'on retire le tuyau IV (12) de l'ensemble de pompage (14).

4. Système d'interdiction d'écoulement libre selon la revendication 3 , caractérisé en outre en ce que le passage de logement de pince (18 ; ou 18B) est formé dans l'ensemble de retenue (16 ; ou 16B) libérable et comporte une extrémité ouverte destinée à recevoir la pince flexible (20 ; ou 20B) et en ce que l'ensemble de retenue (16 ; ou 16B) libérable est agencé de façon à pouvoir être déplacé entre une position de montage et démontage (figure 2) vis-à-

vis de la pompe à perfusion (10), position dans laquelle le tuyau IV (12) peut être monté dans l'ensemble de pompage (14) ou en être démonté et le coin (22) et la pince flexible (20 ; ou 20B) sont dans leur position de démontage, et la position de fonctionnement (figure 3) dans laquelle le tuyau IV (12) est retenu dé façon à permettre un fonctionnement de l'ensemble de pompage (14), le coin (22) étant monté sur la pompe à perfusion (10) et positionné dans le passage de logement de pince (18 ; ou 18B) de façon que les branches de serrage (24) de la pince flexible (20 ; ou 20B) soient déplacées de leur position de fermeture à leur position d'ouverture par le coin (22) lorsqu'on fait passer l'ensemble de retenue (16 ; ou 16B) libérable à la position de fonctionnement.

5. Système d'interdiction d'écoulement libre selon la revendication 4, caractérisé en outre en ce qu'un rebord de butée (40 et 41) est prévu sur la pince flexible (20 ; 20A ; ou 20B) pour limiter l'insertion de la pince flexible (20 ; 20A ; ou 20B) dans le passage de logement de pince (18 ; ou 18B) à une première distance prédéterminée, et en ce qu'un bras pivotant (58) ou doigt de retenue (35) est prévu pour retenir d'une manière amovible la pince flexible (20 ; ou 20B) dans le passage de logement de pince (18 ; ou 18B) lorsqu'on insère la pince (20 ; ou 20B) de la première distance prédéterminée, la fente (26 ; ou 26A) de la pince (20 ; 20A ; ou 20B) définissant un axe longitudinal de la pince (20 ; 20A ; ou 20B), tandis que la première position (28) et la seconde position (30) du tuyau IV (12) sont espacées le long de l'axe longitudinal de la pince flexible (20 ; 20A ; ou 20B) d'une seconde distance prédéterminée pratiquement égale à la première distance prédéterminée et que l'ensemble de pompage (14) comprend une paroi (48) interdisant pratiquement un déplacement du tuyau IV (12) dans le passage de logement de pince (18 ; ou 18B) lorsqu'on insère la pince flexible (20 ; 20A ; ou 20B) dans le passage de logement de pince (18 ; ou 18B), de sorte que le tuyau IV (12) passe de la première position (28) à la seconde position (30) lorsqu'on insère la pince flexible 20 ; 20A ; ou 20B) dans le passage de logement de pince (18 ; ou 18B) de la première distance prédéterminée.

6. Système d'interdiction d'écoulement libre ou groupe à tuyau IV selon les revendications 1 ou 3, caractérisé en outre en ce que la pièce d' ouverture de pince (22) se présente sous la forme d'un coin (22) monté sur l'ensemble de pompage (14) de façon à pouvoir être déplacé vis-à-vis du passage de logement de pince (18 ; ou 18B) entre la position de démontage (figure 2) et la position de fonctionnement (figure 3), le système d'interdiction d'écoulement libre ou groupe à tuyau IV étant caractérisé en outre en ce que la pince flexible (20 ; ou 20B) comprend en outre une partie formant pont (44) articulée qui définit une extrémité intérieure de la fente (26), en ce que les branches de serrage (24) de la pince flexible (20 ; ou 20B) s'étendent vers l'extérieur à partir de la partie formant pont (44) articulée et se terminent par des extrémités libres (46) qui définissent l'extrémité extérieure de la fente (26), en ce que les extrémités libres (46) des branches (24) convergent vers l'intérieur en direction de la fente (26) et de la partie formant pont (44) de façon à guider le coin (22) dans l'extrémité extérieure de la fente (26) entre les branches de serrage (24), en ce que les branches de serrage (24) définissent une partie (30) de la fente (26) qui est sensiblement adjacente à l'extrémité intérieure de la fente (26), en constituant la seconde position (30) qui a une largeur normalement inférieure à la largeur de la fente (26) à l'endroit de la première position (28), et en ce que les branches de serrage (24) comportent des parties (28) qui sont sensiblement adjacentes à leurs extrémités libres (46) et définissent une zone d'ouverture (28) sensiblement adjacente aux extrémités libres (46), en constituant la première position (28) dans laquelle la largeur de la fente (26) est suffisante pour permettre à la pince (20 ; ou 20B) de se déplacer dans le sens de la longueur le long du tuyau IV (12).

7. Système d'interdiction d'écoulement libre ou groupe à tuyau IV selon les revendications 1, 2 ou 6, caractérisé en outre en ce que les branches de serrage (24) et la partie formant pont (44) de la pince flexible (20) comprennent un corps, formé de matière de résine thermoplastique ou synthétique, et une pièce (42) formée d'un ressort à action élastique qui exerce une sollicitation sur les branches de serrage (24) vers leur position de fermeture.

8. Système d'interdiction d'écoulement libre ou groupe à tuyau IV selon la revendication 7, caractérisé en outre en ce que les branches de serrage (24) s'étendent suivant une direction longitudinale de la pince (20 ; ou 20B) et en ce que la fente (26) est allongée suivant la direction longitudinale de la pince (20 ; ou 20B), la pince (20 ; ou 20B) comprenant en outre deux rebords (40 et 41) qui s'étendent transversale-

ment vers l'extérieur à partir des branches de serrage (24) opposées, pratiquement dans la même position longitudinale le long des branches (24), et qui servent à limiter la distance dont on peut insérer la pince flexible (20) dans le passage de logement de pince (18 ; ou 18B) de la première distance prédéterminée, tandis que la première position (28) et la seconde position (30) sont espacées le long de la fente (26) d'une seconde distance prédéterminée pratiquement égale à la première distance prédéterminée.

Fig. 1

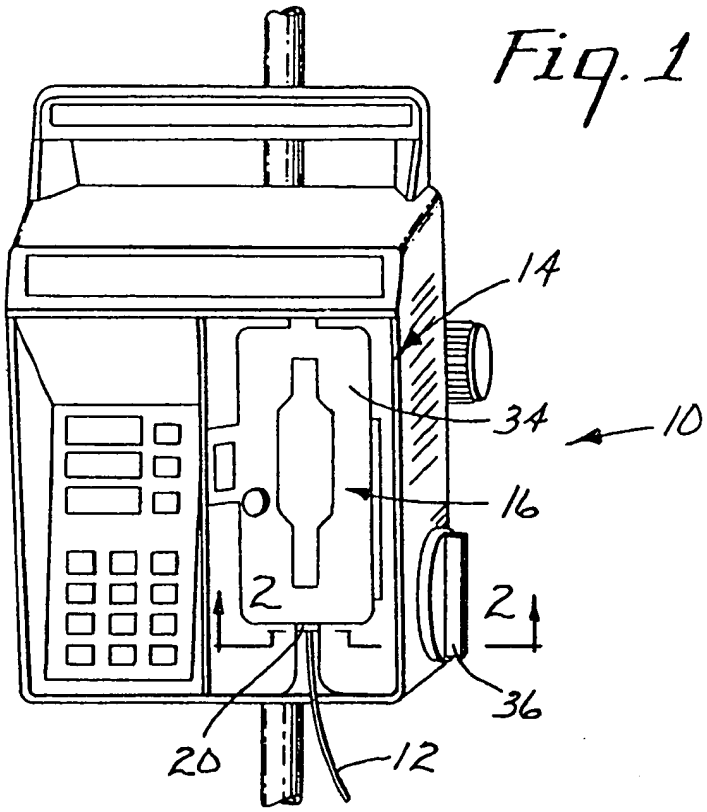
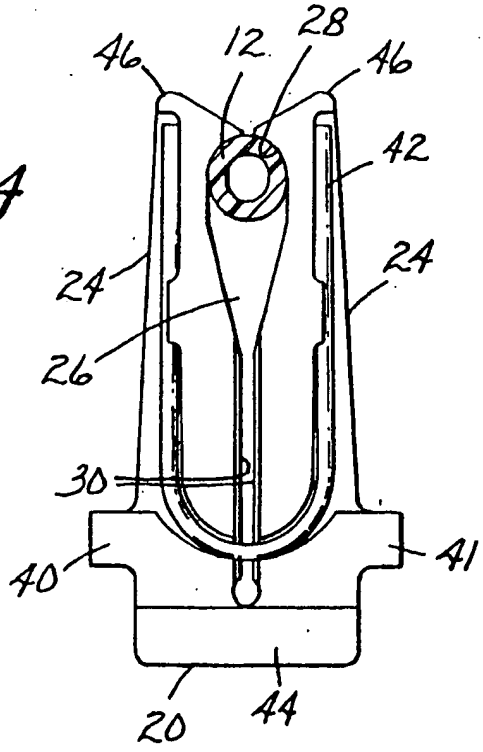


Fig. 4



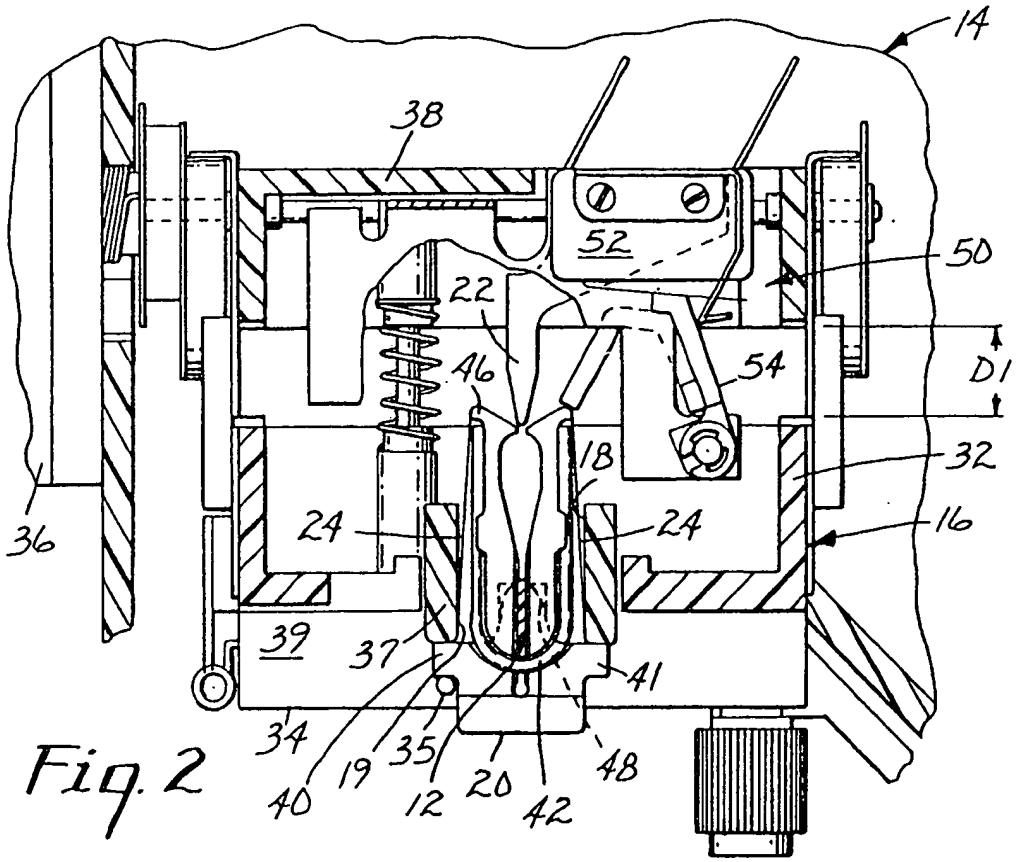

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Fig. 2

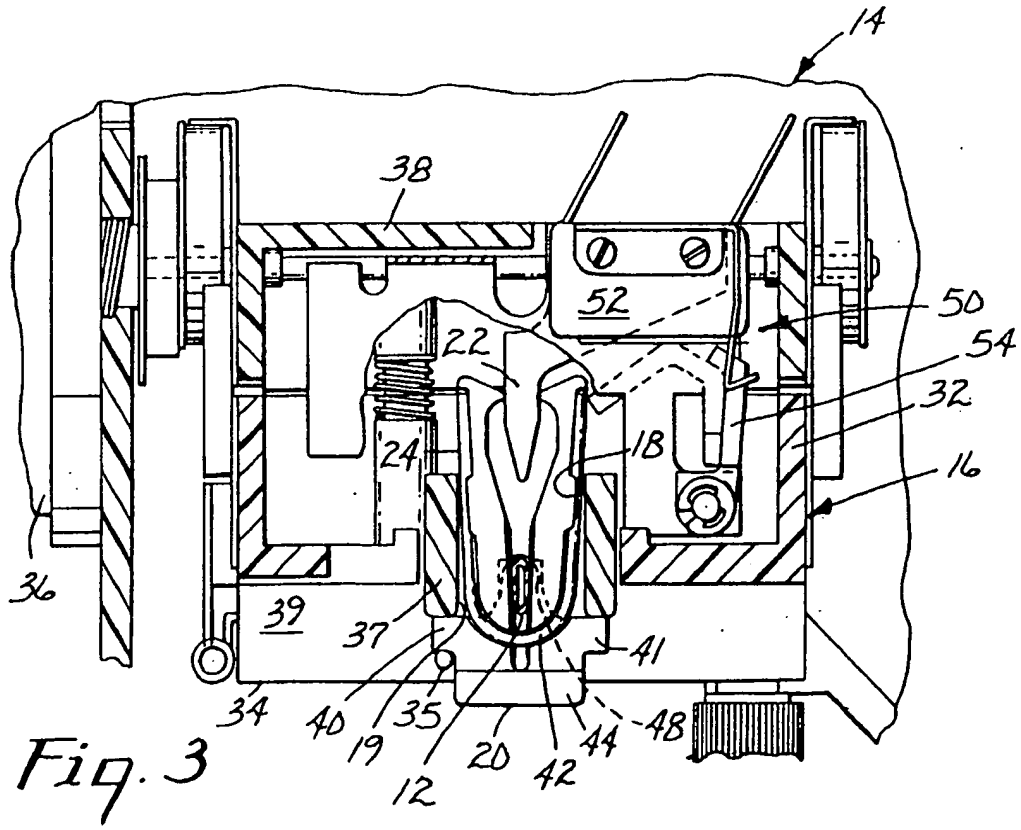
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Fig. 3

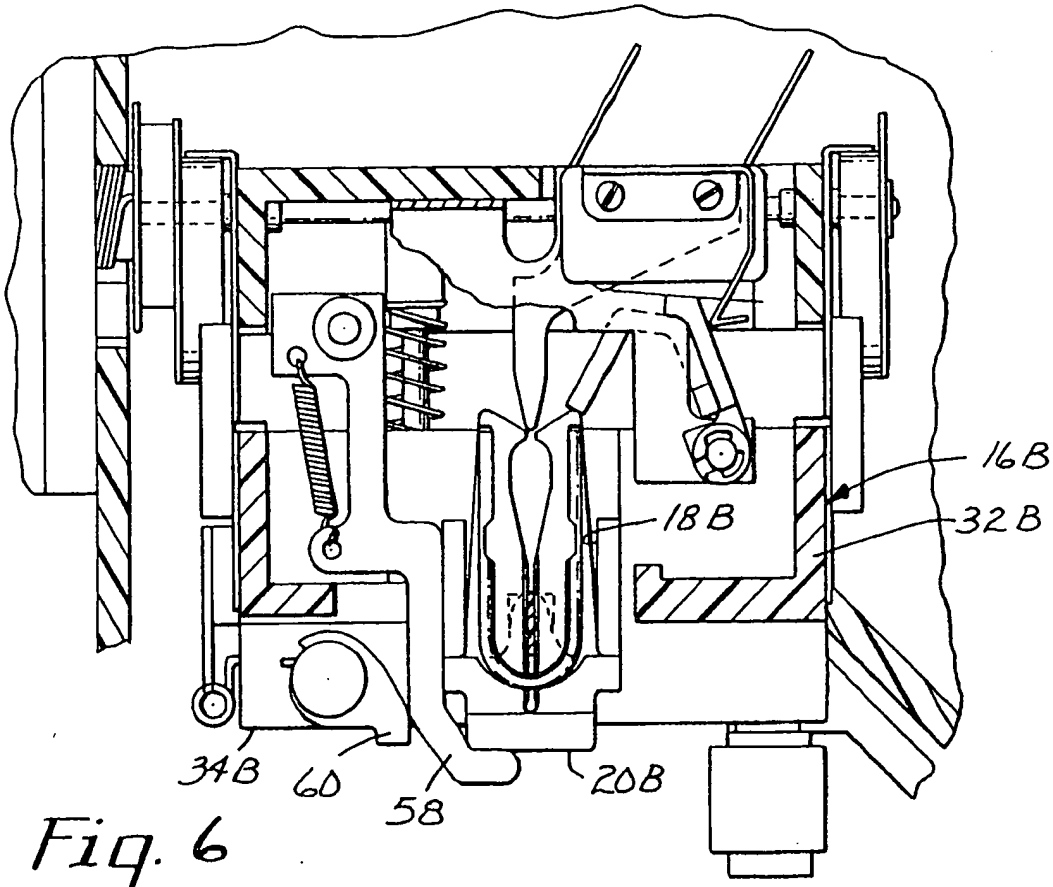

Fig. 6

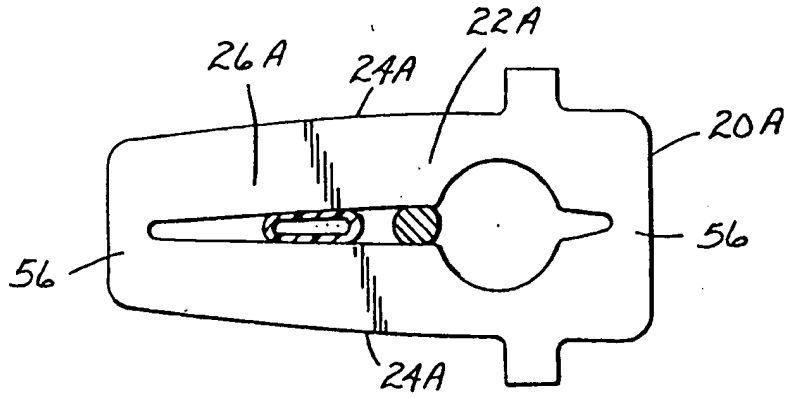

Fig. 5